CALIFORNIA STRUCTURAL ENGINEERING
SEISMIC EXAMINATION OUTLINE

I. Development of Seismic Design Criteria

Selection of design criteria, investigation of site conditions, and selection of structural systems.	
Job Tasks	**Associated Knowledges**
*T1*** Evaluate applicability of building codes/ guidelines. *T2* Evaluate geohazard, and geotechnical and site-specific seismic criteria (e.g., seismic maps, geotechnical investigation). *(Note: 'seismic maps' refers to spectral maps.)* *T3* Select structural systems based on various factors (e.g., seismic criteria, cost, architectural constraints, performance objectives). *T4* Determine structural performance objectives (e.g., serviceability, strength, collapse prevention, life safety, immediate occupancy, continuous operation). *T5* Determine special design requirements (e.g., vertical and horizontal irregularities, torsion, directional effects).	*K01* K of lateral force requirements for elements of structures, non-structural components, equipment anchorage and non-building structures. *K03* K of procedures to determine design requirements for structures with structural irregularities. *K04* K of effects of site geology and soil characteristics. *K05* K of acceptance criteria for various performance objectives considering serviceability, strength and collapse prevention. *K06* K of basic seismology and vibration theory. *K07** K of lateral-force-resisting systems. *K08* K of code prescribed limitations on story drift, building separations, and deformation compatibility. *K09** K of nonlinear behavior of lateral-force-resisting systems. *K11* K of performance of structural systems. *K15* K of response of structures to seismic loads. *K28* K of analysis of foundation systems. *K36* K of design for: diaphragms. *K37** K of design for: Specific lateral-force-resisting systems. *K50* K of base isolated structures. *(Note: 'base isolated structures' refers to seismically isolated structures.)* *K51* K of passive energy dissipation devices. *(Note: 'passive energy dissipation' refers to structures with damping systems.)* *K53* K of anchorage of nonstructural building elements including equipment anchorage. (*Note: 'building elements' refers to components.)* *K56* K of design for properties of building materials. *K66*** K of investigation and evaluation procedures using applicable guidelines. *K67* K of failure mechanisms for different types of structural elements and/or connections in existing structures. *(Note: 'structural elements' refers to structural components.)* *K68* K of yield mechanism for different types of structural elements and/or connections in existing structures. *(Note: 'structural elements' refers to structural components.)* *K69* K of foundation systems in existing structures. *K70* K of historical design procedures and codes for assessing existing structures. *K71* K of performance of structural systems of existing structures. *K84*** K of mitigation options for structural strengthening based on applicable codes, guidelines and/or life-safety criteria. *K85* K of remedial measures to repair structural and nonstructural damage, deterioration, and defects of existing structural members and connections. *K86* K of preparation of structural specifications for strengthening of existing structures. *K87* K of structural testing, inspection and observation for strengthening of existing structures.

**Note: In K07, K09 & K37 'lateral-force-resisting systems' refers to seismic-force-resisting systems.*
***Note: In T1, K66 & K84 'guidelines' refers to referenced standards.*

K=Knowledge

CALIFORNIA STRUCTURAL ENGINEERING
SEISMIC EXAMINATION OUTLINE

II. Seismic Analysis of New and Existing Structures

Determination of type, magnitude and combinations of loads that act on new, existing and non-building structures; determination of external and internal forces and deformations generated by loads.

Job Tasks		Associated Knowledges	
*T6**	Determine the seismic load path (e.g., vertical and lateral force-resisting elements, diaphragms, drag struts, connections, foundation). *(Note: 'drag struts' refers to collectors.)*	*K01*	K of lateral force requirements for elements of structures, non-structural components, equipment anchorage and non-building structures.
		K03	K of procedures to determine design requirements for structures with structural irregularities.
		K04	K of effects of site geology and soil characteristics.
		K05	K of acceptance criteria for various performance objectives considering serviceability, strength and collapse prevention.
		K06	K of basic seismology and vibration theory.
T7	Determine applicable load combinations.	*K07****	K of lateral-force-resisting systems.
		K08	K of code prescribed limitations on story drift, building separations, and deformation compatibility.
T8	Construct and use free-body diagrams.	*K09* **	K of nonlinear behavior of lateral-force-resisting systems.
		K10	K of lateral pressures on earth retaining structures due to seismic ground shaking.
T9	Determine structural modeling and characteristics of the structure (e.g., stiffness, mass, damping, boundary conditions).	*K11*	K of performance of structural systems.
		K12	K of diaphragm rigidity and deflection.
		K13	K of material standards.
		K15	K of response of structures to seismic loads.
		K17	K of dynamic analysis procedures to determine seismic forces.
*T10***	Calculate seismic forces for structures:--by static force procedures.	*K18***	K of static force procedures to determine seismic forces.
		K19	K of calculating seismic design base shear.
		K20	K of calculating vertical distribution of seismic forces.
		K21	K of calculating horizontal distribution of seismic forces.
		K22	K of calculating overturning moment and stability of the structure.
T11	Calculate seismic forces for structures:--by dynamic analysis procedures.	*K23*	K of modeling techniques for computerized structural analysis programs.
		K24	K of interpretation of results from computerized structural analysis programs.
		K25	K of effects of structural irregularities and structural discontinuities.
		K26	K of analysis of diaphragms assumed to be flexible.
T12	Analyze structural systems to determine:--forces in members and connections, deformation, and stability (e.g., moment frames, braced frames, shear walls).	*K27*	K of analysis of diaphragms assumed to be rigid.
		K28	K of analysis of foundation systems.
		K29	K of analysis of lateral pressures on earth retaining structures due to seismic ground shaking.
		K30	K of analysis of frame structures.
		K31	K of analysis of shear wall structures.
T13	Analyze structural systems to determine:--building drift including horizontal torsion.	*K32*	K of calculation of story drifts.

**Note: In T6 'lateral force-resisting elements' refers to seismic-force-resisting systems.*
***Note: In T10 & K18 'static force procedures' refers to equivalent lateral force procedures*
****Note: In K07 & K09 'lateral-force-resisting systems' refers to seismic-force-resisting systems.*

K=Knowledge

Determination of type, magnitude and combinations of loads that act on new, existing and non-building structures; determination of external and internal forces and deformations generated by loads.	
Job Tasks	Associated Knowledges
T14 Analyze structural systems to determine:--forces in horizontal diaphragm elements (e.g., drag struts, chords, at discontinuities). *(Note: 'drag struts' refers to collectors.)*	*K33* K of analysis of statically indeterminate structures using—manual calculations. *K34* K of analysis of statically indeterminate structures using—computer programs. *K66* K of investigation and evaluation procedures using applicable guidelines. *(Note: 'guidelines' refers to referenced standards.)* *K67* K of failure mechanisms for different types of structural elements and/or connections in existing structures. *(Note: 'structural elements' refers to structural components.)* *K68* K of yield mechanism for different types of structural elements and/or connections in existing structures. *(Note: 'structural elements' refers to structural components.)* *K69* K of foundation systems in existing structures.
T15 Analyze structural systems to determine:--forces in vertical and lateral force-resisting elements (e.g., at discontinuities, boundary elements, braces, uplift). *(Note: 'lateral force-resisting elements refers to seismic-force-resisting systems.)*	
T16 Perform dynamic linear analysis to determine structural characteristics and response.	
T17 Determine deformation compatibility of elements not part of the lateral-force-resisting system. *(Note: 'lateral-force-resisting system' refers to seismic-force-resisting system.)*	
T18 Determine seismic forces on elements of structures, nonstructural components and equipment.	

K=Knowledge

Design of elements and connections for new, existing and non-building structures using a variety of materials such as steel, concrete, wood and masonry including recommendations for seismic repair and/or strengthening.

Job Tasks	Associated Knowledges
*T19** Determine design requirements for all structural elements in the seismic load path (e.g., vertical and lateral force-resisting elements, diaphragms, drag struts, connections, foundation) and recommendations for seismic repair and/or strengthening. *(Note: 'structural elements' refers to structural components and 'drag struts' refers to collectors.)*	*K01* K of lateral force requirements for elements of structures, non-structural components, equipment anchorage and non-building structures. *K03* K of procedures to determine design requirements for structures with structural irregularities. *K04* K of effects of site geology and soil characteristics. *K05* K of acceptance criteria for various performance objectives considering serviceability, strength and collapse prevention. *K06* K of basic seismology and vibration theory. *K07** K of lateral-force-resisting systems. *K08* K of code prescribed limitations on story drift, building separations, and deformation compatibility. *K09** K of nonlinear behavior of lateral-force-resisting systems. *K10* K of lateral pressures on earth retaining structures due to seismic ground shaking. *K11* K of performance of structural systems. *K12* K of diaphragm rigidity and deflection. *K13* K of material standards. *K15* K of response of structures to seismic loads. *K17* K of dynamic analysis procedures to determine seismic forces. *K18* K of static force procedures to determine seismic forces. *(Note: 'static force procedures' refers to equivalent lateral force procedures.)* *K19* K of calculating seismic design base shear. *K21* K of calculating horizontal distribution of seismic forces. *K22* K of calculating overturning moment and stability of the structure. *K23* K of modeling techniques for computerized structural analysis programs. *K24* K of interpretation of results from computerized structural analysis programs. *K25* K of effects of structural irregularities and structural discontinuities. *K26* K of analysis of diaphragms assumed to be flexible. *K27* K of analysis of diaphragms assumed to be rigid. *K28* K of analysis of foundation systems. *K29* K of analysis of lateral pressures on earth retaining structures due to seismic ground shaking. *K30* K of analysis of frame structures. *K31* K of analysis of shear wall structures. *K32* K of calculation of story drifts.
T20 Determine detailed systems design requirements (e.g., detailing for combinations of systems, deformation compatibility, adjoining rigid elements, ties and continuity, building separations).	
*T21** Determine appropriate:--seismic provisions for lateral force resisting systems and elements based on the material types.	
T22 Determine appropriate:--seismic provisions for foundations.	
*T23** Determine appropriate:--seismic provisions for elements that are not part of the lateral force-resisting systems.	
*T24** Design and detailing of:--members of vertical and horizontal lateral force resisting systems.	

**Note: In T19, T21, T23, T24, K07& K09 'lateral-force-resisting systems' or 'lateral force-resisting elements' refers to seismic-force-resisting systems.*

K=Knowledge

Design of elements and connections for new, existing and non-building structures using a variety of materials such as steel, concrete, wood and masonry including recommendations for seismic repair and/or strengthening.

Job Tasks	Associated Knowledges
T25 Design and detailing of:--connections of vertical and horizontal lateral force resisting systems. *(Note: 'lateral-force-resisting systems' refers to seismic-force-resisting systems.)*	*K33* K of analysis of statically indeterminate structures using—manual calculations. *K34* K of analysis of statically indeterminate structures using—computer programs. *K36* K of design for: diaphragms. *K37* K of design for: Specific lateral-force-resisting systems. *(Note: 'lateral-force-resisting systems' refers to seismic-force-resisting systems.)* *K50* K of base isolated structures. *(Note: 'base isolated structures' refers to seismically isolated structures.)* *K51* K of passive energy dissipation devices. *(Note: 'passive energy dissipation' refers to structures with damping systems.)* *K53* K of anchorage of nonstructural building elements including equipment anchorage. (*Note: 'building elements' refers to components.)* *K56* K of design for properties of building materials. *K63* K of preparation of structural specifications. *K64* K of structural testing, inspection and observation. *K66** K of investigation and evaluation procedures using applicable guidelines. *K67*** K of failure mechanisms for different types of structural elements and/or connections in existing structures. *K68*** K of yield mechanism for different types of structural elements and/or connections in existing structures. *K69* K of foundation systems in existing structures. *K70* K of historical design procedures and codes for assessing existing structures. *K71* K of performance of structural systems of existing structures. *K72* K of post-earthquake safety evaluation of structural system for intended occupancy (e.g. damage or distress, excessive deformation). *K73* K of structural systems in existing structures. *K80* K of anchorage of nonstructural building elements including equipment anchorage in existing structures. (*Note: 'building elements' refers to components.)* *K84** K of mitigation options for structural strengthening based on applicable codes, guidelines and/or life-safety criteria. *K85* K of remedial measures to repair structural and nonstructural damage, deterioration, and defects of existing structural members and connections. *K86* K of preparation of structural specifications for strengthening of existing structures. *K87* K of structural testing, inspection and observation for strengthening of existing structures. *K88* K of properties of building materials in existing structures.
T26 Design and detailing of:--horizontal diaphragms and bracing systems, drag struts, chords and details of splices and connections. *(Note: 'drag struts' refers to collectors.)*	
T27 Design and detailing of:--connections between elements in the seismic load path.	
T28 Design and detailing of:--foundations for seismic forces.	
T29 Design and detailing of:--elements and connections of structures, nonstructural components and equipment anchorage.	
T30 Design and detailing of:--non-building structures.	
T31 Design and detailing of:--connections between cladding elements and structural members.	
T32 Examine potential retrofit options for compliance with applicable design criteria and/or budgetary or architectural constraints.	

** Note: In K66 & K84 'guidelines' refers to referenced standards.*

K=Knowledge

***Note: In K67 & K68 'structural elements' refers to structural components.*

Design of elements and connections for new, existing and non-building structures using a variety of materials such as steel, concrete, wood and masonry including recommendations for seismic repair and/or strengthening.	
Job Tasks	Associated Knowledges
T33 Design for compliance with applicable criteria to:--meet strength and stiffness requirements. *T34* Design for compliance with applicable criteria to:--increase ductility. *T35* Design for compliance with applicable criteria to:--mitigate irregularities and discontinuities. *T36* Design for compliance with applicable criteria to:--increase local and global stability. *T37* Design for compliance with applicable criteria to:--repair damage and/or deterioration (e.g., shear walls, connections). *T38* Design for compliance with applicable criteria to:--strengthen connections. *T39* Develop feasible options and constructible details considering the existing conditions of the structure. *T40* Upgrade exising structure to meet current code requirements or the applicable level of compliance.	

K=Knowledge

Evaluation of the structure to determine seismic deficiencies based on applicable design criteria and recommendations for seismic repair and/or strengthening.

Job Tasks	Associated Knowledges
T41 Review available construction documents. *T42/43* Conduct field observations, investigate, and document existing conditions by field observation and measurement. *T44* Review, request, or specify test(s) for material strengths and properties [e.g., tension, compression, shear test(s)]. *T45** Evaluate the structure to determine seismic deficiencies and/or to determine non-compliance with applicable design criteria (e.g., vertical and horizontal lateral force resisting systems and elements, seismic load path, connections). *T46* Determine seismic hazard mitigation requirements.	*K01* K of lateral force requirements for elements of structures, non-structural components, equipment anchorage and non-building structures. *K03* K of procedures to determine design requirements for structures with structural irregularities. *K04* K of effects of site geology and soil characteristics. *K05* K of acceptance criteria for various performance objectives considering serviceability, strength and collapse prevention. *K06* K of basic seismology and vibration theory. *K07** K of lateral-force-resisting systems. *K08* K of code prescribed limitations on story drift, building separations, and deformation compatibility. *K09** K of nonlinear behavior of lateral-force-resisting systems. *K11* K of performance of structural systems. *K13* K of material standards. *K15* K of response of structures to seismic loads. *K28* K of analysis of foundation systems. *K53 **** K of anchorage of nonstructural building elements including equipment anchorage. *K56* K of design for properties of building materials. *K63* K of preparation of structural specifications. *K64* K of structural testing, inspection and observation. *K66* K of investigation and evaluation procedures using applicable guidelines. *(Note: 'guidelines' refers to referenced standards.)* *K67*** K of failure mechanisms for different types of structural elements and/or connections in existing structures. *K68*** K of yield mechanism for different types of structural elements and/or connections in existing structures. *K69* K of foundation systems in existing structures. *K70* K of historical design procedures and codes for assessing existing structures. *K72* K of post-earthquake safety evaluation of structural system for intended occupancy (e.g. damage or distress, excessive deformation). *K73* K of structural systems in existing structures. *K80**** K of anchorage of nonstructural building elements including equipment anchorage in existing structures. *K86* K of preparation of structural specifications for strengthening of existing structures. *K87* K of structural testing, inspection and observation for strengthening of existing structures. *K88* K of properties of building materials in existing structures.

K=Knowledge

**Note: In T45, K07 & K09 'lateral-force-resisting systems' refers to seismic-force-resisting systems.*
***Note: In K67 & K68 'structural elements' refers to structural components.*
****Note: In K53 & K80 'building elements' refers to components.*